Part

B

Section 7: Science Advisory Panel Members and Minutes of Panel Meetings

Science Advisory Panel Members

Dr. Martin L. Cody

Dr. Cody is a community ecologist, with extensive experience in bird and plant biology.

Professor, Department of Biology, UCLA
Guggenheim Fellow 1979-80
Author 127 refereed scientific articles

Dr. Peter R. Kareiva

Dr. Kareiva is a population/community ecologist with strong interests in quantitative ecology.

Professor, Department of Zoology, University of Washington
Guggenheim fellow 1989-90
Member, Board of Governors, the Nature Conservancy
Author of 46 refereed scientific articles, 23 book chapters, 13 essays, 4 books.

Dr. William M. Murdoch

Dr. Murdoch is a population ecologist, with strong quantitative interests, and extensive experience of resource management in California.

Professor, Department of Biological Sciences, UCSB
Director, National Center for Ecological Analysis and Synthesis 1995-6
Guggenheim fellow 1977-8
MacArthur Award, ESA 1990
Committee of National Academy of Sciences on pest control
Director, California Coastal Commission study on power plant effects on ma fine environment.
Author of 109 refereed scientific articles.

Dr. Barry R. Noon

Dr. Noon is a population ecologist with extensive experience in conservation and Redwood forest management (particularly for Spotted Owls).

Professor, Department of Biology, Colorado State *University*
Chief Scientist, National Biological Service 1995
Board of Governors, Society of Conservation Biology
Author of 57 refereed scientific articles

Dr. Martin G. Raphael

Dr. Raphael is a wildlife biologist with extensive experience in forest management.

Team Leader, Wildlife Ecology, Pacific Northwest Research Station, USDA-Forest Service.
Board of Directors, Cooper Ornithological Society
Deputy Leader, FEMAT (Northwest forest Plan)
Author of 92 refereed scientific articles

Summary of Science Advisory Panel meeting

November 21-4, 1996
Lewis and Clark College, Portland

Introduction

Courtney introduced the meeting, and explained it's purpose. Pacific Lumber Company is engaged in the preparation of a Habitat Conservation Plan. Two scientific studies are underway. One, an analysis of habitat use, is to be used in informing the estimate of 'take' of Murrelets under the HCP. The second analysis, a 'population viability analysis' or PVA will inform the estimate of 'jeopardy' - that is the effect of 'take'.

The habitat analysis, and other analyses, will be carried out by Redwood Sciences Lab, in collaboration with SEI staff. The PVA will be carried out by Applied Biomathematics (NY) (Ginzburg and Akcakaya) and SEI (Courtney).

The goal of this meeting was, in a collaborative fashion, to set out the possible structure of the PVA, to identify the data necessary to construct the model, and determine the initial tasks for the scientists engaged in the analyses. The focus of the meeting was on, in an open and cooperative approach, to identify the best available scientific information and data. Our goal was to carry out good science, and to provide useful tools to managers who will draft and evaluate the Habitat Conservation Plan.

Drs. Cody, Kareiva, Murdoch and Raphael comprise the Science Advisory panel. Their role is to advise the scientists carrying out the PVA, and to ensure the quality of the final product as reflecting the best available information on the biology of the Marbled Murrelet. Other workshop participants also played an advisory role in this first meeting.

Initial discussion focused on the need of the decision-makers for the best available scientific tools. Representatives of the US Fish and Wildlife Service supported the need for such information, and that it would be useful in their decisions on approval or denial of the HCP. The USFWS definitions of 'take' and 'jeopardy' were discussed.

Essentially the HCP must set up measures to minimize take, and cannot constitute jeopardy.

Summary of discussions

The first day of the workshop focused on the known and unknown biology of the Marbled Murrelet. What is unknown predominates.

We know little about the status or trends or reproductive success of the species. The best data on 'actual population trends are those from RSL's ongoing studies in northern California. At this point analysis is incomplete, but available analysis suggests that there is no consistent upward or downward trend. These analyses will be completed during the next months.

We also know little about the degree of interchange among populations, although birds are known to be mobile (there was discussion of results of Jodice on daily movement patterns). Similarly we know little about adaptability to changes in habitat. Most of the 165 nests found thus far are in older forest, although a few have been found on platforms in younger forests.

The breeding success of the population is hard to assess. Adult-juvenile ratios are currently in use, but are subject to error. Courtney described identifying a 'juvenile' which had been previously banded as an adult. General discussion at the meeting suggested that low recruitment estimates were suspect at this point. Raphael pointed out that methodology in some studies suggesting declines (e.g. in Alaska) was significantly flawed.

Habitat Study

Miller presented an overview of the proposed habitat study. It was agreed that the results from this study would be extremely valuable to the PVA, and should be incorporated into it. The two analyses should be developed concurrently, and should inform each other.

Demonstration of modeling techniques

Akcakaya and Ginzburg demonstrated the use of RAMAS modeling techniques, as applied to Spotted Owls, California Gnatcatchers, and other species, and showed how the models might be applied to Murrelets. It was clear that gaps in our knowledge of Murrelets

coincided with essential parameters of the models. The Panel advised the use of allometric data from other species were possible.

Spatial Scale

There was extensive discussion about the scale of the analysis. CDFG biologists indicated that their level of concern was the population in California. However the panel and others noted that this is not a biological entity. However the 'coastal redwood habitat' part of the range is essentially similar, and may be a suitable entity to model. The USFWS representatives were more concerned with population viability across the three state range of the listed entity. It was collectively decided that two levels of analysis may be necessary. The initial focus on the local 'bioregion' should be expanded later to a larger scale of analysis.

Continuity

The group discussed the desire for ongoing involvement and updates. Although this has not yet been decided, it may be that a web-site can be used to post information on the PVA, as it is developed.

List of attendees:

Akcakaya, R.	Applied Biomathematics
Bacik, F.	Pacific Lumber Attorney
Brosnan, D.	President, SEI
Burkett, E.	Cal. Fish and Game
Carroll, P	US Fish and Wildlife S
Chinnici, S	Pacific Lumber Co.
Cody, M	UCLA; Panel member
Courtney, S.	SEI, meeting Chair
Detrich, P	US Fish and Wildlife S
Gaither, J	CRA
Ginzburg, L	Applied Biomathematics
Grubba, T	SEI
Henson, P	US Fish and Wildlife S
Jodice, P	OSU
Kareiva, P	U Washington, Panel member
Merizon, R	SEI
Moore, K	Cal. Fish and Game
Miller, S	US Forest S, Redwood Sciences Lab
Murdoch, W	UCSB, Panel member
Nelson, K	OSU
Raphael, M	US Forest S, PNW Research station

Marbled Murrelet Population Viability Analysis

Second Meeting of the Oversight Panel

Notes prepared by Steven Courtney

The PVA Oversight Panel reconvened on June 12 and 13 1997, in Arcata CA, to consider the results obtained by the scientific analyses. The initial impetus for bringing the panel back together was the suggestion of Tom Tuchmann that an impartial scientific evaluation would be useful to decision makers at this point.

The meeting was recorded on videotape. Copies of the tapes can be obtained from CJ's Studio (707-442-5939), or from Steven Courtney. These notes are prepared from the record.

The attached agenda shows the presentations and discussions as they occurred at the meeting.

Introduction

Courtney introduced the meeting, by describing the process that has been developed for the Pacific Lumber HCP, and for the Marbled Murrelet Population Viability Analysis. The original Advisory Group consisted of Cody, Kareiva, Murdoch and Raphael, and was convened to consider the design of the PVA. Kareiva could not be reached for this meeting, but Barry Noon of Redwoods Sciences Lab (soon to be of Colorado State University) has been added to the Team (Raphael arrived at the meeting on the evening of the 12th). Other Murrelet scientists had been invited to attend, but were unable to do so at the short notice necessary for this meeting.

The process that has been developed is to approach the Murrelet PVA in a cooperative and scientific manner. Courtney asked the group to maintain the approach, to acknowledge diversity of opinion where necessary, and to establish consensus where possible. Courtney described the goal of the meeting as a frank evaluation of the analysis to date. He stressed that the science was still in progress, and that

new results were still arriving. An important objective of the meeting was to provide help and guidance over the last few months of this critical phase of the study.

Courtney also described the role of the PVA in the overall science analysis. Several other studies are ongoing in 1997, notably the various aspects of the Habitat Analysis. These other analyses have important roles in evaluating the level of 'take' under any HCP; the PVA will be most useful in examining 'jeopardy'. Of course, the data collected under the Habitat Analysis will also be important input to the PVA model. The Panel's main role is in advising the PVA scientists; however the advice to the Habitat Analysis scientists would also be useful.

Several studies are ongoing in 1997:
PVA Analysis: Final Product by late July/early August
    Supported by Inland detection analysis (Hamer) by late July
Offshore surveys
Habitat Analysis:
    Inland habitat surveys for Murrelets
    Inland habitat description (including State Park)
Capture and radio-telemetry of Murrelets

At the request of the US Fish and Wildlife Service, Courtney also outlined the issues underlying the decision to list the species under the Endangered Species Act, and the goals of the Recovery Plan, which focus on issues of geographic distribution, and both short-and long-term survival. These issues were described in more detail by Paul Henson in a letter (attached) which was circulated at the meeting.

PVA Modeling

Ginzburg reported the results of the population modeling study, essentially unchanged since the May report. This study is continuing and data are arriving from RSL and other sources that will refine the models during summer 1997. This includes GIS data, to develop a spatially-explicit model. Focus is still on the mid-scale model (for Conservation Zone IV), as agreed at previous meetings, but larger (listed region) and smaller scale (bioregion) models will also be

completed. As before, the basic design of the models is taken from the parameters developed in the model of Beisinger.

Discussion of the model focused on the assumptions used in construction. One question concerned the use of strongly divergent estimates of demographic parameters in the sensitivity analysis. It was argued that this approach will result in an over-estimate of the importance of these assumptions. Ginzburg agreed that as we develop a better understanding of vital rates, the analysis will focus our attention on the uncertainty associated with other parameters; however at this point this is still the major source of uncertainty.

Some technical suggestions were made. For instance, it was thought to be biologically unreasonable for density-dependent factors acting through habitat availability to affect the vital rates of sub-adults and juveniles. It was also pointed out that there might be subtle second-order interactions between parameters that have not been captured by the model to date: notably the effect of forest harvest is modeled simply by a reduction in carrying capacity (K), but might reasonably be argued to affect fecundity (increased predation on juveniles in fragmented forests). Ginzburg agreed to consider these issues.

Allee effects at low population levels were discussed. Small scale effects will be missed in population models such as that described here. The group discussed the usefulness of individual-based models in studying this issue.

The panel commented that (under adverse survivorship conditions) logging has small effect on the model results, and some panel members were anxious that this not be misinterpreted as sanctioning large-scale logging. It was pointed out that if the population was indeed discovered to be declining rapidly, then it was unlikely that regulatory agencies would permit large-scale loss of habitat.

Courtney commented that the role of the PVA should not be to provide hard quantitative population projections, but to guide us on what factors are important. The models should also guide us on what we need to know more about. They have for instance focused our attention on parameters that have the biggest effect, including

survivorship. The PVA gives us better decision tools, and points us towards critical data needs. As emphasized in the first PVA workshop, we need to focus attention on what the available data actually say.

Population Trend Data

Ralph, Miller and Matsumoto presented data and preliminary analysis of at-sea survey results carried out by RSL from 1989-present. These studies are ongoing, and part of normal RSL research activity. 1996 data were presented for the first time at the meeting (see appended results). 1996 was a uniformly poor year for Murrelets in northern California with the lowest counts yet recorded on several transects. Analysis of these data using simple regression analysis on each transect mean densities yields some suggestions of downward population trends. The overall pattern of these results is similar to those reported in the earlier report, although that first analysis (on data up to 1995) showed some positive trends that are no longer discernible.

The group agreed that the new data lend some support to the position that population numbers have declined over the period 1989-96. However it is not yet possible to determine the rate of decline, or whether this is ongoing. Neither is it yet possible to ascribe any loss of population to potential causative factors (forest harvest, ocean conditions, rising predator densities). Adjacent areas seem to fluctuate with little evidence of synchrony.

The group also discussed the additional insight that can be gained from use of adult-juvenile ratios. There was a diversity of opinion on the usefulness of these data, although the data collection method itself is well accepted. An important issue that is unresolved is the proportion of the at-sea population that is attempting to breed locally, and whether any of the population are non-breeders (perhaps derived from other populations to the north).

The group pointed out that population trends will be subject to time-lags; hence recent declines could be due to factors operating up to 10 years previously. Conversely, there may be a similar lag in future responses. This delayed response complicates trend analysis, and

suggests a need for sufficient duration of study (10+ years) in order to reach firm conclusions.

Other points discussed by the group included the recognition that monitoring of the population is best carried out on the ocean; the need for power analyses; use of 2km transects as the basis of analysis; the need to include intensive survey data; the potential pseudo-replication problem associated with association of segments; estimates of marine productivity.

There was extensive discussion of statistical methods, including the need to state the ability to distinguish between alternative hypotheses (e.g. stability versus 6% annual decline). Burkett reported on the relation of these issues to those raised by Marine Survey workshops.

Habitat Analysis

Ralph et al reported on the latest data from the Habitat Analysis. The overall thrust of this work is to determine the relative importance of different stands for the conservation of the Murrelet. Alternative estimates of the importance of stands can be made on the basis of habitat area and quality, or by including information on Murrelet detection levels or levels of occupancy.

The basic process is to describe the vegetation types and landscape configurations in the bioregion, and to sample these for Murrelet occupancy. This will then result in a model of the value of different areas for the species.

Recent data have included information on the relative importance of Residual stands on the Pacific Lumber ownership (appended document). These data show that there is higher use of residual stands than had been predicted. Because this result was somewhat unexpected, the data were examined to determine whether the use of residual stands was over-estimated as a consequence of placement of residuals near old-growth, or vegetation types. The data seem to show that this is not the case. Residuals on Pacific Lumber lands are used at high levels even when distant from old-growth, and regardless of habitat type. However it should be noted that use of residuals is still

less than use of old-growth. Moreover, it should be emphasized that these are detection levels, which may be elevated in more open (thinned) stands, with increased visibility. Detection levels also may not be a strong indicator of habitat quality or breeding success, which may be higher in undisturbed old-growth than in more open residual stands. It may also be that Murrelets are associated with only a few residual stands, but at high levels of activity.

There is an ongoing program of inland surveys in 1997. The main thrust of these surveys is to determine occupancy and activity levels in areas that have not received adequate coverage thus far: notably residual stands, the State Park, and some old-growth stands. The program for 1997 will establish a solid sample of all habitat classes (e.g. doubling effort in residuals), and of geographic coverage.

Discussion included: the need for a good measure of nest success and habitat quality; the number of nests that may be found in a single stand in a year; the rate of succession in Redwood forest (e.g. in residual stands); statistical analysis of data on occupancy vs. distance to old-growth; the use of a spatial analysis that would include marine and terrestrial factors. Stopher raised the importance of including distance from the ocean, and topographic features. Murdoch asked whether the number of Murrelets thought to be nesting in the Bioregion could be responsible for all the occupied detections (on 11 000 acres of habitat). Herman pointed out that surveys had been carried out in residuals to determine absence prior to harvest, and would have been selectively placed in ‘better quality’ habitat. Hence there might be a systematic bias to the surveys in these areas, which were not randomly selected.

Detrich emphasized that the conservation strategy will use data ‘on habitat. There was also discussion of the opportunities raised by the continued presence of birds in residual stands after harvest.

The panel also noted that the importance of residual stands will be more easily evaluated when more data are available. These may also suggest alternative management options. For instance, it is possible that further information on nesting success and predator behavior will suggest that unentered old-growth can be thinned without harming

nesting potential of the stand (these data are not yet available). Similarly, it is possible that residual stands are 'sinks' which attract nesting Murrelets, but which are poor breeding locations. Elimination of residuals would therefore have little negative effect on the population. These speculations must however await further data before they could be useful to decision-makers.

Courtney summarized by pointing out that there has been significant progress since the last meeting. Uncertainty has been narrowed considerably. The habitat analysis has already indicated that upper and lower estimates of habitat can be rejected.

Presentation by Ken Moore

There has been a diversity of opinion on the amount of Murrelet habitat on Humboldt Redwoods State Park. This is an important issue, because it determines the proportion of Murrelet habitat in the Bioregion that is protected, or at risk from logging.

Moore, who has suggested that the amount of habitat in the State Park is low, presented the panel with a slide show illustrating his experience with the Park, and with Murrelet habitat in the region. He stressed that although he lacked quantitative data, and therefore was presenting 'guestimates', he had extensive experience in delimitating habitat on the ground.

On the basis of this experience, Moore estimated that there was less than 10,000 acres of Murrelet habitat on the Park, of varying levels of 'quality'. He emphasized that ongoing research by Ralph, and the current Murrelet survey efforts would resolve any remaining differences, and supported this effort. A site-visit or separate meeting might be useful when these are complete.

Discussion

Predation and Fragmentation: Burkett emphasized that fragmentation studies from East Coast forests are being applied here, in very different forest types. Data are available from some Redwood forest work (by Suddjian etc), and show that harvest history does not seem to affect corvid (predator) numbers. Proximity to humans however

does increase predator numbers. Courtney reported on work by himself and other SEI scientists that shows similar patterns.

Murdoch emphasized how important data on actual nest success could be to management of e.g. residual stands. This would also affect our understanding of, for instance, the effects of predation on vital rates.

There was extensive discussion of the possibility of increased mortality during dispersal from the natal nest site to new nesting areas. Mortality during such dispersal was not thought to be significantly greater than normal over-winter mortality.

Cyclicity of the marine environment was also discussed. Temporal correlation (runs of good or bad years) might be important, and affect population predictions form PVA models. It was pointed out that mortality in some seabirds under EL Nino events can be catastrophic. It might be that birds such as Murrelets cannot breed at all in El Nino years, given their 'marginal' life-history. Data on marine trends are being collected by D.Brosnan (SEI) and should be incorporated into models.

Cody emphasized the importance of using detection levels and occupancy levels to 'weight' the stands, such that more value is given to areas with many detections.

Murdoch stated that, if the population is declining to a new equilibrium at a low K, then new logging will lead to further decline if K is reduced further. The length of the lag of this response cannot be longer than the average life-span of the bird.

Estimates of survivorship and breeding success are critical, and data on these factors should be collected if at all possible. The panel again emphasized the difficulty of working with this species, and the need to narrow down opinion on critical variables.

<u>Presentation of Agency Questions</u>

The USFWS (through P. Henson) and the CDFG (through M. Stopher) had, prior to the meeting, developed a list of questions for the panel

(see attached documents). Courtney had developed a precis of these questions, which was presented to the panel as the final agenda item for the first day of work (see attached documents). The panel were asked to consider these questions as a guide to the needs of the parties, but not to be limited in their comments. The panel were urged to pass comment on the process as followed thus far, on the quality of the information and the analysis, and on what reasonably could be deduced at this point. Guidance for future decisions and for future analyses was also sought. The panel was also asked to set limits on how the data could be used. Courtney pointed out the consequences of making scientific errors in different directions, and asked for advice on the most appropriate interpretation under these circumstances. The panel was also asked for advice on design features to be incorporated in conservation plans. Detrich asked for the panel's assessment of the use of the PVA and Habitat Analysis process in the regulatory arena.

Panel Response

The panel met independently of the larger group to develop their responses. The panel had some consensus, and went as far as they could in answering the questions that were posed. Their main points can be summarized as follows:

1. The Panel is impressed with the process developed by SEI to address this 'classical conflict situation' of groups with competing goals. The process appears to be working well.

2. The Panel feels well qualified to evaluate the work so far.

3. The Panel is impressed with the progress made since the first meeting of the group. Many excellent data have been collected.' Continuing on this path is appropriate. Much better data is now being collected. There will be a qualitative increase in our abilities to understand and manage the species, as more information becomes available.

4. The prognosis for making a good decision is very good, with a few more data.

5. Nevertheless, the Panel is not yet in a position to give definitive answers to agencies' questions. The panel cannot increase the comfort level for those making decisions now.

6. The time-frame for making better decisions is not long (perhaps 5 years).

7. It is likely that a decrease in breeding habitat will lead to further decline of Murrelets, but a definitive answer to this question is difficult at this time.

8. There is more information to be extracted from existing data, which can be analyzed relatively swiftly.

9. Decline of the population is the most defensible hypothesis on population change, especially with the 1996 data. However the panel is not ready to defend this hypothesis. Although the RSL marine data are the best available anywhere in the range of the species, they are still not enough to understand population trends. More data are important. Analytical improvements would help the study.

10. The cause of any decline is unknown. Future trends are also unknown. A priori we might expect to be in a transitional phase as the population adjusts to a new K following timber harvest in the 1980's.

11. We also don't know the breeding success of the population - there may be many non-breeders present. The panel questioned the value of adult-juvenile ratios. Models that predict trends based on demography, habitat history, predators, marine factors should be examined to determine which best predict the apparent trend.

12. The panel did not wish to make any call on 'Jeopardy' of the species or population, at any level (bioregion or listed range). The panel saw no way to add to comfort levels on this decision right now.

13. The panel was supportive of adaptive management. Information gathered in the next few years would be critical, and should be incorporated into management.

14. Some panel members advocated that the conservation management process should explicitly incorporate information needs and uncertainty. Models of the management process should be updated through an ongoing monitoring program with decisions that are conditioned by the results of the monitoring.

15. The adaptive management process should, as far as possible, avoid irreversible changes

16. Some changes to the PVA were suggested.

17. Additional statistical support should be provided to the study of population trends. This should include a weighted analysis, and an estimate of power. This process would also help in the future allocation of survey effort.

18. The process is making significant headway. This is good science. The gaps between divergent opinions have narrowed. For instance, it is now apparently agreed that Pacific Lumber does not own 50% of the available Murrelet habitat (outside of the Headwaters); neither does the Company own as little as 12%. The true figure is probably in the range of 25 to 33%.

19. The panel cannot give sensible answers to many questions (e.g. 3, 4, 5,6, on list provided) at this point.

20. It will be difficult to make good decisions now with the available information. However if the decisions can be deferred, they may be good decisions. The data being collected and developed now are qualitatively better. It is critical to keep this process going. A FEW more years will make a big difference to statistical power.

Cody argued that extra effort, and continued data collection is needed now because: A. the analysis is at a ‘qualitative crux’ statistically, and B. the population itself is probably at a critical transition phase (this will not be true in 5 more years). Data collection needs to continue. This will not need to be an open-ended process. A few more years will make a much stronger case - beyond that additional effort would be pointless. The current data collection is proceeding well.

The panel also generally agreed that early conservation/management decisions should be tentative, and that later decisions need be less so, because the quality of the data will be far superior.

There was some discussion of the concept of an 'interim strategy', involving harvest of stands of least conservation value, and continued data collection over the next 5 years, using adaptive management. Courtney pointed that the Butano Creek THP provides a model and precedent of this. The panel suggested prioritizing of stands, perhaps on the basis of the number of Murrelets detected on surveys. It would be difficult to prioritize at this point. Raphael suggested incorporating information on nest predation into the process. Reid suggested setting up alternative prioritization models, and determining of the same results are predicted using different criteria.

Adaptive manaaement and Information needs

The panel had strong opinions on the need for further information. They argued that the inferences that could be drawn now were weak, and would not be of much help in making critical decisions. It was emphasized that this was not a simple case of scientists asking for more and more research. Instead the data are at a critical point, where a few more years data will make a large difference in the quality of data and of decisions. Regression analysis in particular is at a critical juncture, where 3 to 5 years' data will resolve the population trend issue.

Noon emphasized the need to incorporate uncertainty into the decision-making process. Monitoring is an essential part of the adaptive management process; otherwise monitoring is a pointless activity. A five year time frame seems appropriate.

The panel identified additional data to be collected:

Movement patterns of Murrelets between populations (banding?)

Telemetry studies to find nests, and estimate proportion of population breeding

Nest success in different habitats

Tree-climbing for nests in different habitats

Historical analysis of vegetation harvest

There should also be an integrated program of research and monitoring, carried out in one place, not spread over a geographically diverse area (e.g. banding in Puget Sound!)

Models that predict trends based on demography, habitat history, predators, marine factors should be examined to determine which best predict apparent trends. There also needs to be an understanding of causation, not just correlation. What factors are responsible for the changes in numbers?

Other needs:
Better trend estimate techniques
Check raw data
Data go-between for PVA and Habitat Analysis
Possibly, a behavioral/ individual-based model

There may also be opportunities that develop from analytical results - for instance the use of residual stands as potential recovery habitat.

<u>Concluding remarks</u>

Detrich pointed out that in November he had 'put his foot in it' and suggested that sensitivity analysis would be valuable. It has been really valuable, even if the ambiguity is frustrating. We have more clearly defined what we know and don't know. We have also demonstrated that we have done the best science we can; even if at this juncture the science can't help, some hope that it will in future.

Stopher reiterated these points and emphasized that existing data, and upcoming analysis on trends and on State Park habitat will be very valuable.

Courtney closed the meeting by pointing out the progress that had been made, prior to and during the meeting. There was now general agreement that the data indicated some decline in the population. There was also consensus that the amount of habitat on Pacific Lumber lands (outside of the Headwaters Complex) constituted c. 25 to 33% of the habitat in the Bioregion. The PVA models have successfully identified that assumptions on life-history parameters determine the outcome of population projections. Perhaps most importantly, there is general recognition that the best possible science has been brought to this issue, but that important questions are unresolved, and will remain so in the short-term.

Given the difficulties and the emotive power of these issues, the group has been extraordinarily successful. The cooperative attitude of all participants has led to important progress.

Agenda

June 12/13 1997

Mad River Saloon, Arcata

June 12

10.30	Introduction The HCP Process	Courtney
10.50	Reports on Results PVA	 Ginzburg
11.20	Population Trend data	Ralph et al
1.30	Habitat Analysis	Ralph et al
2.50	Humboldt Redwoods State Park	Moore
3.30	Discussion	
4.30	Presentation of agency questions	S.Courtney

June 13

Panel Meeting 8.00 to 9.30

9.30	Response to questions	Panel
11.30	Adaptive management	
12.30	Meeting ended	

Third Meeting of SEI Headwaters Project Science Advisory Panel
San Francisco November 10

Minutes prepared by S. Courtney

(Video tape available)

Courtney opened the session by reviewing the process SEI has developed in these meetings. This has been a cooperative approach, which has focused on the development of tools. We have thus far avoided advocacy positions, and tried to develop science-based consensus. So far this has worked well.

The Science Advisory panel was originally drafted to help oversee the Population Viability Analysis (PVA). This meeting is the first time that it has acted to advise on the other analyses. Tom Tuchmann has also asked that the panel review the work of agency staff- the panel is well respected by all parties, and recommendations have been valued.

Courtney then reviewed the science that is being carried out by various groups. Several analyses were identified at an early point in the program:

PVA - This work considers the long term effects of management options on the population of the Marbled Murrelet. in essence this is work that will advise on the potential for 'jeopardy' of various actions: will management options lead to the loss of the population or the species. This is therefore an analysis of potential impact; it is carried out by Applied Biomathematics (AB) and SEI (Courtney). This research has been the focus of two previous panel meetings and the workshop in March.

Habitat analysis. This work informs the PVA, and is essentially an analysis of the amount of habitat or conservation value lost and preserved under different options. This will guide parties in their assessment of 'take'.

The initial task of the habitat analysis is to develop consensus tools that can be used by all parties - in effect to craft a common language with which to discuss the potential effects of management.

Update on PVA

The first panel meeting set out the process, and guided AB and SEI on the development of models. The March workshop helped parameterize these models, and establish a range of alternative values for consideration. The second panel meeting allowed the panel to evaluate how far the science had proceeded, and to make appropriate recommendations. The panel also discussed the extent to which the PVA could help with negotiations; the panel discussed the advisability of deferred options that would allow science to reach stronger conclusions.

The basic demographic models (as presented at the 2nd panel meeting) have been taken as far as possible at this point. We need ancillary studies to reach completion, so that parameter values can be improved, and the range of uncertainty over the models reduced. These studies are mostly nearing completion. These are:

Habitat analyses (today's discussion)
Population trend data
Marine factors presumed to have effect (report here at meeting)
Oil spill data
Analysis of variability and correlation between populations (Hamer)

The PVA is continuing. We anticipate a report becoming available in January or February, using the best available data at that point.

The LIMBS model is a parallel process, using individual based models. Material was forwarded to the panel by the authors (some of whom are present), but will not be discussed at this meeting. if appropriate this may be discussed at future panel meetings.

Where are we in the negotiation process? Some positive developments have occurred. The federal appropriations appear secure. State appropriations are less sure, and may end up as a

bond issue. There may also be Congressional hearings on the science results.

Negotiations are proceeding: several ideas have been put forward and sent out as alternative proposals.
3 main proposals are under consideration. The MMCA (Marbled Murrelet Conservation Area) approach, put forward by USFWS and others, preserves substantial part of old-growth, and substantial areas of second-growth which will be used as recovery habitat.
The current company proposal is to defer hard decisions 'the August HCP', where a lot of old-growth is set aside for interim period. This proposal derives in part from the panel's previous statements that hard decisions might be better deferred.
The 'Toggle proposal' also defers some decisions. A smaller amount of potential habitat (three stands) is set aside in interim, and one of these areas is then subsequently selected to be added to the reserve.

There is some distance between these proposals. We need tools, to help to decide which proposal best meet management objectives. it is not our goal to advocate one proposal over another - instead we should try to develop common language and tools for evaluating these proposals.

Paul Henson agreed with these statements, and emphasized that the political process is ongoing and urgent. It needs to be tied together with science; we are being urged to get the science done as quickly as possible, because we are at a critical stage in negotiation.

Habitat analysis
The work reported today is just one part of one part of the science. it characterizes what is habitat in the bioregion. It is important to state that this is just one part of a prioritization process that will identify where are the most valuable areas. This prioritization will include not just how many birds are detected, but also fragmentation, distance to ocean etc.; these other analyses are not yet well developed. The overall goal is a ranking of areas on a range of parameters; if we can agree on ranking, then the negotiations can focus on where the cut-off for protection will lie.

RSL analysis

CJ Ralph presented the analyses to date (see handout). The methodology in use was very different from previous (ARCO) studies of similar issues. There are many assumptions in the analyses (treated in report).

There are two basic metrics - straight habitat acreage; habitat weighting by bird detection levels (traditional approach in other animals). This is a part of a larger ongoing landscape analysis (from Coos Bay to Santa Cruz). Another year's work is projected.

A major assumption is that the number of birds detected in some way reflects the importance of stands - this relationship could even be linear (extreme point of view). Also we assume that sampling and temporal variability in detections at a station doesn't affect conclusions

RSL used three metrics to assign stations to particular habitat types, as explained in materials: Method 3, the proportional method (using GIS) - observations assigned to habitats within 200 m. Method 2 - used most abundant habitat. Method 1 - most complex and likely, using decision tree.

Panel discussion focused on allocation to habitat types under method 1 - is it reasonable?. Data have been spot-checked in many cases.

Noon stated that this methods assume a priori understanding of what constitutes habitat - this involves big assumptions. Courtney pointed out that this is consistent with other approaches (e.g. PSG protocol).

The methods then take allocation at stations, and expand analyses to stand levels. Data are summarized within stands - not across stands. Stand boundaries are defined on both natural boundaries, and on basis of having enough stations.

Raphael and Kareiva questioned using a model of habitat related to station detection to scale up to evaluate stands. The model could be reliable or unreliable. What proportion of variation in detection levels is explained by the three approaches? Maybe some much better than

others? Jodice suggested using estimates based on proportion of visits with detections.

1992-6, old-growth declined in southern Humboldt region by 1½ %, residuals by almost 40%, combined - about one third of habitat lost in time period. Little decline has occurred from 1996-97.

Nelson: we need to understand variability within a habitat type (e.g. OG, R1 in terms of actual habitat characters - i.e. platform abundance - do the categories capture much of the info we need? Should we extrapolate up without checking on the ground? Ralph indicated that some of these checks will be carried out - but other areas have been cut. Nelson also queried use of the 200 m radius circle - why? Ralph indicated that this value -could be changed to 50 or some other figure. Miller indicated that detection levels drop off beyond 200m. if we alter this distance we would change detection intensity, but we are not likely to alter relationship among stands.

Raphael: This method assumes detections are proportional to use. We also have to assume the probability of detections is comparable. Ralph: we tried to be conservative by analyzing stands across not just small areas.

Ralph: there are no big differences among the three metrics in the results obtained. If we look just at occupied detections (higher variance) - Headwaters increases in value by 5%. Large areas in State Park decline by 10%.

Noon: cautiously suggests that shouldn't feel comfortable that methods are similar. The methods rely on assumptions common to all methods, concerning detection probability 'little p'
There are three ways it comes in:
Radius - assumes is constant (using distance)
P is constant across sites
P is constant across time at a site

Methods are available to study these assumptions, using covariates in analysis, such as habitat variables. Results of such analyses will determine comfort level with habitat analyses, They might also allow us to determine which way there will be departures (e.g. closed-

canopy underestimated, and stands which are heavily closed therefore under-valued).

Presentation of Paul Henson

There are important assumptions in detection methodology, and in applying the methods right now. Eventually we need some method of getting at Murrelet density - there are some studies in place (e.g. radar, tree-climbing, multiple observers at each station) that will get at that. How precise are methods NOW? Methods and data are important to the extent that they differ in allocation of birds to parks or PL lands.

Henson discussed the problems using the Ralph approach and concluded that it was not a reliable methodology to use at this time. He had concerns regarding Ralph's assumptions #'s 1, 2, 5, 6, and 7, but due to time constraints chose not to discuss these at this time. Instead, he focused on providing three examples of applying the Ralph method to see if the results were biologically reasonable.

in example 1, Stand 2 has 546 acres of residual habitat that appears to be of relatively low quality. it had no occupied detections. Yet it had the highest RBV of all stands except for HW/EHS and HRSP. it was higher than all the stands with unentered old growth, such as Stand 3 (Bell Lawrence). Stand 3 has 1030 acres of old growth and had multiple occupied stations, yet it had a lower RBV than stand 2, as did many other higher quality stands. In Henson's opinion this RBV result does not make biological sense.

Example 2 reveals a similar pattern. Larabee Cr. (Stand 20) has 427 acres, mostly Douglas fir, and is the farthest inland of the stands. It had only one occupied station, yet it ranked out higher than many other higher quality and larger stands with more occupied detections.

in Henson's third example, he compared HRSP with HW. HRSP had approximately 1600 acres of occupied old growth. HW had approximately twice that (@ 3200 acres). Yet because of extrapolation of "bird value" to large areas within HRSP that did not have occupied detections, HRSP receives a much higher RBV than HW.

In Henson's opinion, these three examples illustrate that the detection method can give misleading results by according high value to relatively lower value stands, and vice versa. He suggested that some reasons for these misleading results may be:

1. that total detections is not really describing the phenomenon of interest (i.e., nesting murrelets - see Ralph's assumption #I);

2. there are no precision measures with the data,

3. Similarly, there are no hypotheses posed and tested; it is simply assumed that differences in mean values used to compare populations (i.e., stands) are absolute and therefore different

Henson concluded that it was not a reliable methodology to use at this time to weight the relative value of stands or to estimate the amount of take that would occur under an HCP. The Service recommends using categorical data that describe occupancy and relate this to proximal habitat attributes.

In summary, RSL studies confirm analysis that earlier suggested that the habitat in the park is largely along Bull Creek and Eel River. The remaining habitat up slope is of limited value; there are some birds nesting in there, but we are unsure how many - probably far less than extrapolation methods suggest. There is certainly some relationship between detections and density, but we are unsure what relationship. Lack of precision estimates makes the data hard to evaluate or accept <u>now</u> - normalizing, and transforming the data may help. Before that, however, we need to know if the data are even measuring what we want (nesting density) - radar and nest searches could help. The RSL method is one method of how to rank stands - but it is premature to apply these results in decision-making.

Courtney raised the issue of how to proceed - if these metrics are not comfortable to Henson, what should be used? We cannot avoid making decisions - what is best available metric?

<u>Timeframe for decision-making</u>

There was also discussion on the issue of timeframe, as set by the congressional clock. Frank Bacik was not sure that we even has two months - is a snapshot possible now? The form of the HCP has to be agreed in December or January for the process to meet timelines. The panel should be encouraged to make longer term suggestions - some options allow management decisions to be deferred depending on outcome of science over next several years (as recommended by panel at last meeting). If however we are not going with deferred options, we need as much information now as is possible.

Tom Tuchmann: We have till March 1999 to complete process. Working back from this, we have till January or February to make an agreement. We need perspective on what is the range of reasonable management options that science allows. What are areas of agreement and disagreement?

Presentation by Reid

Tom Reid reviewed and presented different management alternatives, their economic costs, and geographic distribution of conservation (see handout). He questioned whether we need ranking - most alternatives don't need rankings in order to evaluate them (e.g. MMCA). Also some stands fall out as obviously more or less important (Headwaters, Park) - do we need greater accuracy? Other stands are more or less equivalent; it will be hard to rank these usefully. It is not even that important given the scale of question we are considering.

What metrics can we use to guide us among alternatives? One possibility is to look at a range of metrics, and to use the ones that we are most comfortable with. Are there even dramatic differences among metrics? Maybe they all give the same answer.

Noon: We should seek the configuration which maximizes objective function (conservation value) given economic constraints.

Courtney: other criteria to be added to objective function:
RBV
Fragmentation edge effects
Stand size

Distance to other reserves
Distance to ocean
Recovery Habitat
Species composition
Quality of habitat

Reid and Gaither presented an analysis of ranking of stands using fragmentation as the criterion. 50 m of the stand is defined as edge; 300' outside this is set up as buffer. This is an exercise - not an analysis that is to be used or where assumptions will be defended. The focus is on the method - is it useful? It's an alternative method, not using detections, therefore avoiding the problems associated with detection methods.

Noon: dollar maximum is the constraint that should be used. It is easy to write a simulation model that looks at all the combinations, and sees which combination comes out the best in terms of the objective function.

Murdoch: there are no real data on 'edge' in the Limbs model.

Cody: this method defines the issues in such a way that define small stands to have little value. The value of core is set at four times that of edge - this is an arbitrary value, not well supported by data.

Raphael: The assumption drives the outcome. Research work in WA and OR doesn't support the idea of the edge effect - human habitation may be more important. The risk of predation is the driving question, not edge. Edge effect is an open question. Cody - even possible that core with edge is accessible.

Gaither: assumptions need to be tested I agree, and there are limitations in the method's justification - but these principles are being put in place - e.g. in MMCA, because we need to make decisions. May be some data coming (Nelson).

Burger: both this approach and that of RSL are deterministic not stochastic. We need to compare analyses for congruence - also to look at sensitivity to adding individual stands - are there thresholds where one stand makes a big difference?

Panel recommendations

These are the logical and essential steps that are necessary for a spatially explicit HCP. This is specifically directed at the next few weeks and months.

1. RSL should not use 'all detections' as the response variable
2. Occupancy is the most biologically relevant variable - use that. Occupied detections should be used (not nests or other metric based on occupancy). Circling not discussed for possible inclusion
3. Relate the occupancy data to site-specific attributes - this should be done at the level of the individual survey station. RSL should explore variation in occupancy on the basis of station attributes, using regression.
4. Analysis should then scale up from the station level to stand level.

Analysis should examine variation in occupancy as explained by variation in habitat attributes. It should explore variance in per-visit detection likelihood as a function of site attributes - this will get at issue of whether p is constant across time, and across sites. There are two general ways to do this: 1. Using subset of data where there are multiple visits to sites, variable distance methods will determine whether p varies as a function of habitat type. If there is no difference in detection functions with habitat, then safe to make assumption that p is constant across habitats. 2. The alternative approach is multinomial logistic regression; to estimate the probability of making a correct call on occupancy as a function. of habitat variables. This gives a station specific per visit detection rate, and hence your likelihood of getting a false negative as a function of habitat type.

Assuming that we solve all these problems - we now have a biologically meaningful metric. We should have looked at all the assumptions that are inherent in this metric e.g. RBV, tested them, and made adjustments on the basis of biases. The next step is a straightforward optimization economic analysis where costs are constraints. Given the likelihood that there are disagreements over what the economic costs really are, we should look at the marginal increase in the metric as a function of economic cost -this is the easy step in the analysis.

Gaffney: what is the basis for bringing in economics, in science or law. Noon: this is not a scientific argument. We are making decisions in the face of uncertainty, and estimating the utility of possible outcomes. Estimating utilities is not a scientific process - it is a value based process. Detrich: we could take this idea, but also add the statutory constraint, so we could do this analysis and see how close we are to that constraint.

Noon: HCP should be an experiment, updated through monitoring - if birds not behaving as envisaged, we need to revisit model.

There was general discussion of the possibility of source-sink dynamics - but no data are readily available. If such dynamics are found, they have implications for release of small stands, and growth of buffers (mitigation).

Kareiva: Our suggestions are ways to examine data to evaluate the proposals that have been put forward. There is lots of value in this data set that can be brought out.

Courtney: even after all these metrics are in, there are still other weightings we might want to add. So how should we do this ? Cody: we would like to use the number of fledged Murrelets. We would then be able to project over next 50 years to look at recovery habitat. Murdoch: this is our idea of what to do with existing data - but there is nothing to stop you building in experience or results based on data. It important to distinguish this proposed analysis - what the data tell you - from 'biological insight'. You should add in these other metrics to weight alternatives.

There was general discussion on how long this new analysis would take to do. Ralph: the work is feasible and valuable - but the entire list is not doable in 4 weeks. Murdoch: someone could do logistic regressions and analysis of p in 4 weeks - but not the economic cost-benefit analysis. Batik: there is willingness on the part of the company to make this happen. Tuchmann: also wants to see it happen.

There was discussion on the productivity metric. The panel's response was to carry this out on a longer timescale, when there are sufficient data. It can be brought in as a weighting factor. It can also be turned around to ask: how big a difference would there have to be between edge and center to alter results? - we don't have enough data yet to answer this question.

Courtney asked: are the occupancy data the best available scientific information - should decision makers make decisions on that basis? Panel: Yes in the short term, and in terms of take - in terms of sustainability, long-term value might include recovery potential.

Discussion of value of detection versus occupancy data

Burger: work in BC correlates habitat variables with occupied detections or total detections. There is no relationship with all detections, but a good, consistent relationship with occupied detections. He has 7 and 3 years data in two sites - and therefore has some confidence in metric. Burger endorses the panel approach of using occupancy.

Jodice: he is carrying out intensive surveys - within year variability is high. Coefficient of Variance across a summer is 40 to 130% - but if we look at just occupied detections, CV comes way down. If we look at areas where there are known nests, surveys make correct decisions >90 % of time. The surveys tend to get the call on occupancy status right - the variance in number of detections is much higher. Jodice endorses the idea of working on occupancy. On basis of four to six visits, numbers of detections alone could lead you to wrongly suggest that one stand had more birds than another stand.

Murdoch: CJ has wonderful data for getting at what's happening in a stand - Kim Nelson has beginnings of data on productivity. Raphael suggests that variables from logistic regression be forwarded to Kim so that she can apply them in her studies.

Meeting closed at 4 pm

Minutes of Fourth Meeting of Science Advisory Panel

Prepared from videotape by S. Courtney

The meeting was held at Santa Barbara, May 26 and 27 1998.

In attendance:

Panel Members

M.Cody	UCLAP.
Kareiva	U Washington
W. Murdoch	UCSB
M. Raphael	USDA- Forest Service

(B. Noon CSU, absent)

Others

F. Bacik	Pacific Lumber Co
S. Chinnici	Pacific Lumber Co
R. Cody	
S. Courtney	SEI
P. Dietrich	USFWS
J. Gaither	Cal Resources Agency
K. Moore	CDFG
T. Reid	Consultant to CRA
M. Staupher	CDFG

Minutes

Courtney opened the meeting and emphasized how much has been achieved. The panel have been major contributors, and have ensured the scientific standards of the process. The credibility of the HCP has depended on outside review and the direction of the panel. New analyses have been carried out at the panel's suggestion, and these have been helpful.

The original intent of the scientific process was to respond to the agencies' needs for additional information. The science was crafted to answer these particular information needs. Since the last panel meeting, the agencies collectively decided on an appropriate conservation strategy (setting out areas to be conserved) which was ultimately accepted by Pacific Lumber Company (PalCo). The company has now prepared a pre-review draft Habitat Conservation Plan (HCP) under this strategy. There are now some issues on which both the agencies and PalCo need additional guidance in the final phases of HCP preparation.

The draft HCP has been based on the best available science. The agencies' decision, and PalCo's plan have both depended heavily on the available data and analyses. Where

analyses were unavailable or incomplete, or where there was substantive scientific disagreement, a conservative or 'worst-case' scenario was always adopted. Of course, there have been continuing analyses, and our understanding of Marbled Murrelets continues to improve. Two recent analyses have been carried out (on offshore population trends, and inland survey detectability) and are presented as part of the HCP. However these two analyses have not resulted in any change to the HCP, because of the plan's conservative strategy or 'precautionary principle'.

Offshore analyses

Linear regression analysis on offshore data to 1997 are now available. The Redwood Sciences Lab group of CJ Ralph have prepared a document, which will be incorporated into the revised HCP. The main results of this analysis are that in the northernmost sections of California, the Marbled Murrelet population appears stable or increasing; off southern Humboldt County, the population appears to be decreasing at 4% annually. However all populations seem to show an increase in 1997.

Despite these analyses, the HCP has been drafted under the assumptions that the predictions of Beisinger (1995) are correct, i.e. that the population is declining range-wide at 4 to 6% annually. Given uncertainties over the analyses carried out to date on the offshore data, the HCP was drafted under the 'worst case assumption' that declines were ongoing. This approach was also consistent with the opinion of the Science Advisory Panel at the Arcata (2nd) meeting.

Kareiva reported on the results of analyses carried out by a graduate student at the University of Washington, on a partial data set (as reported by RSL on their web-site). These data, which refer only to the years up to 1995, were subjected to Maximum Likelihood Estimation techniques, which are probably the most appropriate technique. The partial data set suggest that the rate of decline may be larger than 4% for the period to 1995, and that there is 'no chance of no decline'. However the estimate of rate of decline is quite sensitive to the way that data are blocked, and to the assumptions of the analyses. The panel discussed these analyses at length, and suggested that they should be repeated with more recent data as these become available. This will be particularly important to monitoring programs. However the HCP itself was crafted with the assumption that there is an ongoing real decline, and hence should be robust against changes in our understanding of the rate of decline.

Reid suggested that the group should attempt to distinguish among three sorts of ongoing information:

1. any work that is essential to the completion of the HCP (such as agreement on take estimates)

2. work that is useful in evaluating the HCP (e.g. in the EIS process).

3. work useful in supporting the approach taken in the HCP (e.g. the strongly conservative assumption of ongoing decline can be supported by more complete analysis of the offshore data).

Inland survey data: analysis of occupancy

At the San Francisco (3rd) panel meeting, it was decided to engage a statistical consultant, G. White (Colorado State University) to determine whether the assumptions of RSL's analysis of occupancy were reasonable. Specifically, the group was interested in determining whether the assumptions of the 'Relative Bird Value' (RBV) approach, that the probability of detection of occupancy was constant across habitat types and time, were reasonable. If the assumptions were invalid, it might still be possible to develop a correction factor to weight different habitat types.

White's report on these analyses indicates that there is indeed significant variability in the probability of detecting occupied behavior. This probability varies with year, season, and to a lesser degree with habitat. The significant between-year variation is probably due to an artifact: 1995 data are heavily skewed by surveys carried out in that year in Humboldt Redwoods State Park (prime habitat). Within year variation however is large, and is consistent with our knowledge of nesting chronology of the species.

The most important part of the analysis concerns differences among habitats. White shows that there is statistically significant variation in detection probabilities, with detection of occupancy (when birds are present) being highest in Old-Growth Redwood, intermediate in Residual stands, and lowest in mixed Old-Growth with Douglas Fir. However these differences, although statistically significant, do not translate into large errors in weighting. Because several visits to a site (10 under the current protocol) are necessary to determine occupancy, the actual error introduced by differences in detectability is very small (on the order of 1%). Hence the observed between-habitat variability, while real, has little effect on the analyses carried out by RSL and others.

Despite the positive outcome of these analyses, which suggest that the RBV approach has some merit, the HCP did not make use of this method. Instead a more conservative method of estimating Take was adopted, which assumes that there are no differences in density of Murrelets in different stands. This approach will be highly conservative in that the major reserve areas (e.g. Headwaters, MMCAs) are accorded the same weighting as less suitable areas. The HCP therefore adopts the 'worst-case' precautionary approach.

The group discussed White's analysis and felt that it was valuable, although the strategy of the HCP renders moot the results of the analysis. The group noted that White's finding, that detectability varied with habitat type, itself suggested differences in density of Mm-relets in the three habitat types considered. The group also felt that the analysis could and should be taken further, particularly during the monitoring phase of the HCP.

The HCP

There was a general discussion of the pre-review draft HCP, the strategies used in developing the plan, and the placement of MMCAs. The need for buffers was discussed, as was the role of the HCP in the recovery process (the HCP is not required to contribute to recovery of the species, but cannot jeopardize it). Generally, the only potential or actual habitat areas that will be harvested, with the exception of one old-growth stand, are small, unbuffered, and furthest from the ocean of the stands considered.

Mitigation under the HCP was discussed. It was agreed that mitigation was being achieved through habitat set asides. Forest succession is unlikely to result in new nesting habitat in the short-term, but may contribute to habitat quality by buffering, and provision of shelter to marginal nest-sites.

Reid presented a recent analysis of 'Take', or the expected effects of the proposed HCP on Murrelet habitat. The metric uses the most recent data on timber types, and on survey data, to determine the amount of habitat that will be protected under the HCP (most unentered old-growth; some residuals). Reid's goal was to develop a 'worst-case' estimate of Take. He made explicit statements of where his assumptions were conservative, and that a 'best-case' estimate would indicate loss of habitat of far fewer Mm-relets than envisaged in the HCP.

The group generally supported the approach, but identified three sources of error in the method used:

1. The analysis attempts to identify sites that have been 'adequately' or 'inadequately' sampled, and to make correction factors for 'inadequately' sampled stands. However many areas were mislabeled as inadequate, and were in fact surveyed to PSG protocol. This systematic error will lead to some areas that are known not to be habitat being assessed as potential habitat.

2. The method also uses GIS data to assign occupied stations to areas within l/2 mile, without reference to the PSG protocol standard of assigning detections, or to alternative metrics (e.g. that used in the RBV method of RSL). Again, this will lead to a significant error in that occupied behaviors will be assigned to all stands in an area, hence maximizing the areas assessed as potential habitat.

3. The areas that have been surveyed are not randomly selected. Notably, low-quality residual areas are not surveyed (as directed by CDFG staff). High-quality areas are surveyed; estimates of occupancy of residual areas are based only on these surveys in high-quality habitat. Again this will lead to an over-estimate of the amount of habitat on PalCo lands.

In the discussion, the group noted these sources of error, and that, in every case, the error would lead to an over-estimate of Take. The group therefore felt comfortable in assuming that Reid's analysis was successful in setting an upper bound for the Take estimate. The likely amount of actual Take can not be determined at this point, but is less than that assumed the company representatives agreed to incorporate the analysis in the revised HCP.

There was extensive discussion of the use of different habitats by Murrelets. In particular, several of those present thought that the best predictor of habitat quality was the number of potential nesting platforms in the stand. Chinnici noted that past timber harvest practices, when first entering a stand, were to remove trees with platforms, and to leave as residuals the straight trees with few side-limbs. Thus past harvest practices may have eliminated most potential nesting trees in residual stands. Courtney reported opinions of others that the numbers of platforms in residual stands were approximately 1% of those in old-growth stands.

Generally, there was agreement that Reid's analysis was the best 'worst-case' argument (i.e. the approach was a well articulated and supported estimate of the most pessimistic case), and that this conservative approach was the most appropriate way to proceed with the HCP revision for purposes of evaluating potential for take.

Monitoring

Under the HCP, there will be both compliance and effectiveness monitoring. The HCP sets out a program of several techniques.

The group discussed the goals of monitoring. It was felt that it was not possible to develop a program of monitoring with specific feedback loops to management for two reasons. Firstly, mitigation in this HCP is all 'up-front' by setting aside habitat. No additional mitigation will be feasible. Secondly the long lifespan of the bird suggests that there will be long lags in response to any change in conditions. Hence it was thought that 'adaptive management' was not feasible in this HCP. However monitoring should be able to provide information to the agencies so that they can determine whether the HCP is in fact leading to a greater than expected effect (to the level of causing jeopardy).

The group did feel that a program of monitoring was essential, and should include:

1. ongoing oversight by the Science Advisory Panel
2. marine surveys
3. a program of inland surveys/studies
4. statistical/data management support

There was extensive discussion of statistical power. The group felt that it was inappropriate to maintain a '5%' confidence level when considering a population in decline. The standard of statistical confidence should be relaxed (to avoid a Type II error). The exact level to be used should be determined from analyses of the offshore data.

Productivity data (the numbers of young produced) were also discussed. While these have value, and cost little to obtain (since marine surveys are being carried out for other reasons), their interpretation is fraught with difficulty at present.

The group also agreed that the areas north of the bioregion might serve as an appropriate control area. Since there is essentially no harvest going on in these areas, we may be able to compare areas, to determine the effect of harvest levels. This will give more power to analyses (comparison of control with 'experimental' areas).

The group also supported the continued study of RBV and similar metrics that will improve estimates of Take. It is essential to understand the levels of Take in order to make prediction for the monitoring program. Detrich also pointed out that improved metrics may allow further consideration of mitigation options.

The panel generally supported the following:

Compliance monitoring of harvest schedules and effects

Offshore monitoring of populations

Effectiveness monitoring of occupancy in MMCAs and Headwaters

Exploratory work to improve understanding of breeding habitat and its use (e.g. platform density, relationship of habitat characters to occupancy, radar, telemetry, predation risks).

Kareiva, who has reviewed many HCPs recently, noted that an essential component of a good HCP was that monitoring data should be freely available to everyone who is interested in them. This ensures credibility, and that the analyses are well carried out. Data accessibility has been a problem in the HCP. However it should be noted that raw data are essentially useless - very often they must be predigested through partial analysis, before another party could use them.

Murdoch stressed the need for independent scientists to carry out monitoring. The regulated party (PalCo) should not be carrying out the monitoring. Bacik stressed the company's willingness to work with outside scientists, as has been the case with the offshore surveys carried out by RSL, and to incorporate and address the panel's comments in preparing revisions to the pre-review HCP draft reviewed by the panel.

The temporal scale of monitoring was discussed. Murdoch suggested that Ackakaya's models might have value in determining the expected period over which an effect on population trend would become visible.

Panel recommendations

The panel discussed among themselves the HCP and the science used in its development. They were asked to provide guidance on the design of monitoring, the appropriateness of take estimates, and invited to give their opinions on the HCP itself. Their opinions were recorded and presented by Cody (see appended summary).

Important points from their discussions include:

- The HCP is a compromise and should be presented as such.
- Mitigation that can be done, has been done
- The HCP itself is well presented and well organized, although some background information can be supplemented
- The science was used well, but gave ambiguous results; it is appropriate that the HCP at this point takes a conservative and cautious approach
- The PVA was a 'good go', but should not be (as it is not) a major guiding component, because of the ambiguities it reveals.
- The RBV approach could be refined, and would provide a batter and less conservative estimate of take than Reid's analysis,
- Science was essentially used to craft the 'worst case scenario', and to manage to that worst case. This was a sensible thing to do.

The panel generally thought that the HCP had done a good job of identifying areas for conservation value, and that the MMCAs were well placed.

Kareiva stated that, having reviewed approximately 50 HCPs recently, the PalCo HCP was 'one of the better ones' in its use of science.

4TH MEETING OF SCIENCE ADVISORY PANEL, SANTA BARBARA CA
MAY 26-27 1998

"MARBLED MURRELET HABITAT CONSERVATION PLAN DRAFT REVIEW AND DISCUSSION"

NOTES DATED: May 29, 1998 .

COMPILED BY: M.L. Cody

FOR: SEI/Steven Courtney

RESPONSE OF PANEL TO MURRELET HCP PRE-REVIEW DRAFT AND GROUP QUESTIONS

A. General

We were asked for a general opinion of the pre-review draft HCP: was it a "good" plan, perhaps the "best" plan, and had the scientific data been utilized to best advantage? To the former, we could say only that, as it was a done deal, a compromise in which we were not party to the negotiations nor to what the options were, what was on the table, what was flexible and what was not, we cannot comment with any rational analysis. It seems worth saying somewhere that the HCP is a compromise, between on the one hand retaining as much Old-growth redwood as possible for conservation of Marbled Murrelet breeding habitat and on the other PalCo's continuing viability as a lumber concern. To the extent that the agreement is already forged, any mitigation that may take place is already described in the document. Nevertheless, it seems somewhat disingenuous to use phrases to describe the plan such as (p.1, HCP) "provide for improved conditions",... "survival of the species will be assured", ...and "minimize the effects on Marbled Murrelets." It is easy to envisage alternatives which would do these better, but perhaps those alternatives are not available due to constraints we do not know about.

With regard to the use of existing data and projections from it, we noted that the HCP relies to no great extent on existing data, rather adopts a conservative approach in the light of the wide range of uncertainties inherent in the murrelet data at all levels. We concurred that, given the uncertainty in e.g. PVA predictions, it is wisest not to employ these predictions specifically. The HCP is crafted in an appropriately conservative fashion, where worst case scenarios are assumed. We were asked whether any potential risk factors were omitted from the HCP, and note that the PVA mentions a variety of risk factors from the more to less deterministic, from incremental to catastrophic; we agree that it is difficult to be more specific about risk given the nature of the PVA predictions. Nevertheless, there are places in the HCP where more data might be cited to better effect. We noted for example that a) no relative worth is assigned to different habitat patches, and only area is used as a conservation criterion, although there are data that assign

relative value to patches, via data on occupancy behavior, within proposed MMCA's and outside (i.e. Relative Bird Value of Ralph et al); b) the trend data are used (see below), but likely not with the most appropriate of analyses. In both cases, the HCP elects to use a 'worst-case' scenario.

Notably, the proposed MMCA's do appear to be those areas that should be highest priority for Marbled Murrelet breeding habitat conservation. In general, science was used appropriately in the HCP.

B. Impact

No mention is made of impact (as opposed to "Take"), perhaps justifiably so, because the PVA is equivocal on this matter. While the PVA suggests that no serious impact is likely, it nevertheless does describe a reduced probability of persistence with decreased carrying capacity. If carrying capacity is set by area/quality of breeding habitat, some impact is likely as a result of 25% or whatever reduction in breeding habitat.

C. Take

Estimations of Take are fraught with unknowns and complexity, given which we thought that the figures presented by T. Reid were reasonably derived and reasonably conservative. They provide an 'upper limit' or 'worst-case' estimate of take. We noted, however, that Marbled Murrelet populations are down perhaps 85-95% from pre-logging levels, and assuming linearity now between "take" of breeding habitat and "take" of Marbled Murrelet's is an act of faith. All sorts of non-linearities and second-order effects might be operating and thresholds approached: habitat "stepping stones", edge and fragmentation effects, critical levels re facilitation, predation etc. These unknowns should be mentioned, and if a high-end figure of +/- 23% is to be cited it should be well justified.

D. Status

"Status" pertains to the present status of the Marbled Murrelet population and the extent and direction of its population trend, in s. Humboldt Co., in Zone 4 and at large. The best data available are the at-sea census results dating from about 1987. A figure of around -4 to 6% annual decline is cited in the HCP several times, together with a -30% cumulative decline in an appendix. The panel strongly supported better analysis of the at-sea data; P Kareiva believes there is justification to support a figure of - 10% with narrow confidence limits, for a partial data set (to 1995). There may be some evidence for non-linear trends (e.g. upturn following 1995). Log-likelihood estimation of trend should be conducted on the full data set (up to 1997) and separately for different sections of Zone 4, in particular for s. Humboldt Co. where some evidence argues for a steeper decline relative to other sections of Zone 4. This makes sense in terms of continued logging activity over the last decade in s. Humboldt Co. and little if any such activity further n. in Zone 4. If a trend of -10% or steeper is in fact detectable for s. Humboldt Co., it would

behoove the HCP to employ such a figure, as trends in the immediate future will likely be more steeply negative than they are now, and their comparison with -4% would be foolhardy if poorly justified.

For a broader evaluation: a) There might be a possibility of relating the trends determined by at-sea censuses with logging and habitat removal ashore, within Zone 4. b) The at-sea data have never been standardized by indices of detectability, although the data for such corrections are apparently in hand; this might enhance the worth of the trend data and confidence with which they might be invested. c) No use is made of the ratios of juveniles to adults (J/A) at sea. These ratios might still be very useful indices of Marbled Murrelet productivity, especially if the denominator is spring adult numbers. More should be made of these data; however extensive discussion at the meeting suggested these data were of uncertain value d) We have witnessed several strong El Nino events in the last decade, and ENSO years are reported to be poor for Marbled Murrelet breeding success. No analysis of ENSO on either J/A or trend data has been forthcoming, and this might resolve some of the variance in the at-sea numbers.

All data should be used; it is essential that these be publicly available (e.g. on a website). This will build public confidence, and scientific credibility, and assure that the analysis is completed.

D. Monitoring

In summary, the panel recommends that

1. An independent Monitoring Data Manager/Overseer/ Analyst (MDM/A) be employed, in charge of the design, execution and analysis of the monitoring program;

2. Some form of “compliance” monitoring we assume will be a routine part of the program: the removal of potential or actual breeding Marbled Murrelet habitat over space and time, detailed by stand size, location, age, composition etc. will be required;

3. Marbled Murrelet population should continue to be monitored at-sea, possibly with some refinement but in a fashion such that data comparable to those already in hand are collected;

4. There should be formalized monitoring of Marbled Murrelet activity at actual or potential inland breeding sites.

In more detail,

One of the obvious deficiencies of monitoring efforts to date is a wide gap between actual data collection and the completed analysis and summary of such data in the hands of the

agencies that need them (and in part paid for them). We have never, as Murdoch emphasized, been treated to a comprehensively managed data set for any aspect of the program. There have been delays in producing the data i.e. having them available in lucid form for discussion and deployment, and also in their full and statistically defensible analysis. A competent and vigorous MDM/A would go a long way toward solving this chronic problem; it might also obviate the necessity of using outside statistical consultants who are unacquainted with the data collection and Marbled Murrelet biology, though such consultants might still be approached when needed. Given such a person, his/her talents might be employed immediately, as data in hand have been under-analyzed, and the design of monitoring protocols for the next 5-10 years need to be worked out in detail over the next 6 months. A Ph.D. Marbled Murrelet biologist with broad statistical expertise would be best for the position. Data standards and documentation needs should be identified immediately. Timeliness of data transfer should be built into any contracts. The independence of the MDM/A is important. PalCo should ensure capable, independent scientific analysis.

Needs no further amplification.

Comments on the at-sea data set have been made above (see Trends). As far as we know, there are no better ways to monitor Marbled Mm-relet numbers and trends that those which have been employed for many years by RSL; indeed, we think it likely that the data are best collected by RSL in the same way as before. We note, however, that it is essential the MDM/A has immediate access to the full data set and is overseer to its organization and analysis. A framework not only for the data collection protocols (where, when, how often, how made etc.) but for its transit to the MDM/A, assembly, display, analysis, results, conclusions, predictions etc. are required. Continuation of the at-sea counts for at least another decade will be necessary, and for agency purposes perhaps for much longer. Distance data should be used, and density estimated using variable-width methods. Corrections for detectability should be incorporated, as in the inland data. A population trend model (based on harvest schedules and Ackakayya's models) could be used in predicting trends.

Regarding Marbled Murrelet monitoring at inland breeding sites, again we have no basis on which to second-guess the way in which monitoring has been conducted to date; the "occupancy" criteria seem the best available (and practical) for assessing Marbled Murrelet use of actual or potential breeding habitat. Such monitoring should be continued in State Parks, Headwaters Reserve, and designated MMCA's; we see no utility in monitoring at Old-growth Redwood residuals slated for harvest. Design protocols need to be finalized for the inland monitoring program, and we note that the analysis of data collected to date should have a bearing on these protocols. For example, what is the relation between "occupancy behavior" and stand characteristics such as tree height and density, potential nesting platforms, epiphytes, predator density etc.? Then, in turn, what is the relation between stand characteristics thought conducive to Marbled Murrelet breeding and the actual productivity of the site? This is much more difficult, but seems tractable via 1. monitoring nest-leaving juveniles, 2. location of recently fledged juveniles

at sea, 3. use of radar, etc. The data analysis by G. White was useful; its result could be both extended and used. The distinction between detection of occupancy by stand characteristics and differences in occupancy behavior by stand characteristics needs to be sharpened. Then, if detection is very much higher during certain times of the year, i.e. around Julian date 200, perhaps a time when demands of large young for food are maximal, then perhaps monitoring during only those periods is required. The RBV approach of RSL should be further explored, so that relative conservation value of stands can be better evaluated.

There are other aspects of Marbled Murrelet biology that might well be revealed as by-products of the monitoring program, and others that remain as unknown but potentially important; all seem well worth pursuing in order to generate a better picture of Marbled Murrelet biology overall. Some of these data may be collected with little or no additional effort in the Monitoring program. Some of the factors mentioned were:

a) Landscape issues. Originally the PVA was to be integrated, as a second step, with "landscape factors", such that with a better input from the disposition of size, location, stand composition, etc. of breeding habitat the metapopulation results might be sharpened. This has not been done; and it is not clear whether it is worth doing for the sole purposes of the PVA, since metapopulation models assume habitat patches contain all resources required for population growth and have patch size- and location-specific rates of emigration, immigration, extinction and colonization. Clearly patchy breeding habitat for Marbled Murrelet means something quite different, but still a study of these landscape issues may be a productive line of inquiry. Edge and fragmentation effects, the spatial arrangement of patches relative to each other and relative to sea-inland flyways, etc., are landscape factors whose importance or relevance is not yet known.

b) Old-growth Douglas Fir. The estimation of "take" has no component attributable to removal of Old-growth Douglas Fir. This is because no Marbled Murrelet occupancy behavior has been observed in Old-growth Douglas Fir in s. Humboldt Co. We note that elsewhere in CA, as certainly elsewhere in Zone 4 and the 3-state area of concern, Old-growth Douglas Fir is used as breeding habitat, sometimes the preferred habitat. Nearly all of the Old-growth Douglas Fir is outside the MMCA's and slated for harvest. How confident are we that this habitat is not Marbled Murrelet breeding habitat? Is the habitat well-monitored? If it is not breeding habitat, why not? Might it become breeding habitat when Old-growth Redwood declines in area? This seems a worthwhile line of questioning,

c) Human Activity. There has been no critical assessment of the effects of human activity on Marbled Murrelet occupancy behavior or breeding

success, although it seems that some recognition of these effects is pervasive. Could more be accomplished here?

d) Other factors From at-sea (more information of El Nino effects, fish densities and locations, foraging areas, better statistical treatment of census data) to in transit (are Marbled Murrelet's flyway or access limited in their approach to or use of breeding habitat?) to inland sites (predators and their regulation, artificial nests or nest platforms? rate at which new breeding habitat anticipated to come on line for Marbled Murrelet) there is a number of factors which seem worthy of further study, some of which will come from monitoring and some not. A good MDM/A appointment wou1d be invaluable here.